Remarks/Arguments

As a supplement to the distinguishing comments made in Applicant's Supplementary Response filed April 1, 2009, Applicants wish to explain the development of the present invention and the advantageous features thereof with reference to the description of the present specification under "Background Art".

The so-called nutrient fluid cultivation (generally referred to as "hydroponic cultivation") is now widely practiced due to its various advantages over the conventional field cultivation, for example, in that the hydroponic cultivation is free from the problem of soil sickness accompanying sequential cropping.

However, the hydroponic cultivation also has various problems. Especially, since roots of a plant being cultivated are in direct contact with a nutrient fluid, the hydroponic cultivation has problems such as follows: the control of oxygen supply to roots is difficult (when oxygen shortage occurs, the so-called "suffocation of root" is caused, leading to decay of roots); and the contamination of the nutrient fluid with pathogenic microorganisms or other contaminants immediately causes the infection or contamination of the plant and, hence, is a fatal problem.

For solving these problems, various proposals have been made as described at page 4, line 1 to page 5, line 7 of the present specification; however, there has been no prior art which has solved the above-mentioned problems.

Further, US Patent no. 6,615,537 (Tonkin) and EP 1 203 525 A1 (Mori) propose a plant-cultivating system comprising a non-porous hydrophilic film or a porous hydrophobic film, water provided below the film, and a fertilizer-containing soil on the film (see, for example, the Abstracts of Tonkin and Mori, and paragraphs [0040] to [0042] of Mori). In each of Tonkin and Mori, seeds or seedlings are planted in the fertilizer-containing soil on the film and cultivated there. Each of Tonkin and Mori teaches that not only a porous hydrophobic film but also a non-porous hydrophilic film allow the passage of water in the form of <u>water vapor</u> while <u>preventing</u> the passage of any matters <u>suspend or dissolved</u> in the water, and that, therefore, the use of such a film enables controlled supply of water to a plant while preventing infection and contamination

of a plant through contaminated water. Specifically, Tonkin and Mori have the following descriptions:

> "Numerous materials that allow the passage of water whilst restricting the passage of suspended or even dissolved materials are known. One recently identified group of materials are hydrophilic polymers." (emphasis added) (col.1, lines 59 to 62 of Tonkin)

> "Suitable hydrophilic non-porous membranes for use in the present invention are non-porous hydrophilic membranes that absorb water and allow water to pass through only by pervaporation." (emphasis added) (col.4, lines 8 to 11 of Tonkin);

> "the selective moisture vapor-permeable portion not allowing water to pass therethrough, but allowing water vapor to pass therethrough" (emphasis added) (claim 1 or Mori);

> "The moisture vapor-permeability of a film or membrane of a hydrophilic polymer such as the above-mentioned polyvinyl alcohol and various kinds of celluloses can be exhibited on the basis of penetration-vaporization phenomenon of water." (emphasis added) (paragraph [0042] of Mori); and

> "the moisture vapor which is necessary for cultivation according to the present invention is supplied as water vapor passing through the selective moisture vapor-permeable portion, and therefore the quality of the water per se as a source for supplying water vapor is not particularly limited. In other words, it is possible to use any kind of water (such as seawater, hard water, soft water, and polluted water) for the cultivation method according to the present invention, regardless of

the quality thereof." (emphasis added) (paragraph [0074] of Mori)

However, by cultivation of a plant using the system of each of Tonkin and Mori, the growth and quality of the obtained plant are not satisfactory.

On the other hand, EP 0 268 556 A1 (Wright) discloses a plant-cultivating system comprising a porous film (such as a microporous polypropylene film), and an aqueous fertilizer solution provided below the porous film. With respect to the porous film, Wright has the following description:

> "Permeability of the membrane to the aqueous medium is critical, however, and may be caused by "macro-pores" or "micro-pores" (involving or not the molecular structure) provided that the largest openings or pores are small enough to prevent penetration by even the finest plant rootlets and flooding of the plant-exposed side of the interface means under normal conditions. Thus, the pores should in general not exceed about 1 micrometer in diameter and are preferably smaller than 0.1 μm." (emphasis added) (col.6, lines 18 to 27)

That is, Wright teaches that the film (or "membrane") needs to have pores through which "aqueous medium" can be transmitted, but the pores "should in general not exceed about 1 micrometer in diameter and are preferably smaller than 0.1 μm". In the working examples of Wright, a microporous polypropylene film (i.e., porous hydrophobic film) having a pore size of 0.02 μm and a thickness of 130 μm is used (col.12, lines 19 to 21, and col. 13, lines 1 to 4).

It is apparent that Wright attempts to supply the fertilizer solution to the plant (on the film) through the pores. However, it is known in the art that porous hydrophobic film could pass threrethrough water only in the form of water vapor, so that the fertilizer dissolved in the water could not pass the film. For example, attention is drawn to the following descriptions of Tonkin and Mori:

> "Hydrophobic porous membranes will also selectively allow the passage of water whilst retaining dissolved or suspended matter." (emphasis added) (col.2, lines 8 to 10); and

> "In the thus-prepared fine pore-imparted film or membrane, fine pores are formed through which liquid water cannot pass due to the water repellency of the polymer material, and only water vapor can pass through the film or membrane." (emphasis added) (paragraph [0041] of Mori)

Therefore, when cultivation of a plant is performed using a system as disclosed in Wright, the plant cannot absorb the fertilizer so that the growth of the plant is very poor. This is also apparent from the data provided in the Examples of the present application. Specifically, Table 7 on page 58 of the present specification shows that a porous polypropylene film (PH-35) has no ion-permeability, and Table 17 on page 67 of the present specification shows that the plant growth using PH-35 is very poor. (Further, substantially the same results as mentioned above are obtained in the below-described Exhibit 2 of Dr. Yoshioka Declaration submitted herewith.)

In the working examples of Wright, it is described that the cultivation was successful; however, no specific evaluation of the results of cultivation (such as the weight and quality of the obtained plants) is reported in Wright. Further, even if, by some treatment of the porous film which is not descried in Wright, the plant could absorb sufficient amount of an aqueous fertilizer solution through the porous film in the working examples of Wright, this in turn means that the aqueous fertilizer solution per se freely passed through the pores of the porous film so that the film cannot prevent the contamination or infection of the plants and also cannot be used for controlling the water supply to the plants.

In these situations, the present inventors have made extensive and intensive studies with a view toward solving the above-mentioned problems accompanying the prior art. As a result, it

has unexpectedly been found that the above-mentioned problems can be solved by a plant-cultivating system as recited in amended claim 1 (filed on February 20, 2009) which comprises:

a container having a shape capable of receiving a plant to be cultivated;

an aqueous fertilizer solution accommodated in said container; and

a non-porous hydrophilic film for cultivating a plant thereon, said non-porous hydrophilic film being placed on said aqueous fertilizer solution in a manner such that the lower surface of said non-porous hydrophilic film is in contact with the surface of the aqueous fertilizer solution.

Especially, it should be noted that, contrary to the above-mentioned conventional knowledge about a non-porous hydrophilic film (namely, "a non-porous hydrophilic film allows the passage of water in the form of water vapor while preventing the passage of any matters suspend or dissolved in the water"), the present inventors have unexpectedly found that a non-porous hydrophilic film is capable of passing therethrough an aqueous fertilizer solution (this is apparent from, for example, the EC difference values shown in Table 7 on page 58 of the present specification and the Brix concentration (%) difference values shown in Table 8 on page 60 of the present specification), and found that, when a plant is cultivated on a non-porous hydrophilic film placed on an aqueous fertilizer solution, the plant roots integrate with the non-porous hydrophilic film, and the plant having its roots integrated with the non-porous hydrophilic film exhibits enhanced growth and improved quality in terms of Brix (%) value even without providing a fertilizer-containing soil on the film. This finding is totally unexpected from the prior art and is very surprising.

In this connection, attention is drawn to the following description of the present specification.

> "As the former porous type, there are hydrophobic polymer films in which a large number of micropores have been imparted, in which type water vapor passes through micropores but water does not enter micropores due to the hydrophobic property of the film, and thus, it may be presumed, ions as a fertilizer component cannot substantially enter the micropores of the film. On the other hand,

according to the discovery by the present inventor, water and ions as a fertilizer component can easily enter the inside of the latter non-porous type. In this regard, (2) the non-porous type is more suited for the system of the present invention than (1) the porous type. For example, an Example (Example 13) described below shows an example of plant cultivation using a microporous polypropylene film "PH-35" (mfd. by Tokuyama Corp.). In this example, the weight of a plant cultivated for 26 days is 13.1 g for the PVA film, and the growth was poorer at 1 g or less for the microporous polypropylene film, indicating that water and a fertilizer component do not substantially enter the microporous polypropylene film and the plant can not uptake water and a fertilizer component from the inside of the film." (emphasis added) (page 21, lines 11 to 36 of the present specification)

Applicants respectfully request consideration of the amended claims filed on February 20, 2009, and the Declaration of Dr. Hiroshi Yoshioka filed on April 1, 2009. A Notice of Allowance is earnestly requested.

Respectfully submitted,
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